

## Claims

- [c1] 1. An under-ball-metallurgy layer between a bonding pad on a chip and a solder bump, wherein material of the solder bump includes tin, the under-ball-metallurgy layer at least comprising:
  - an adhesion layer over the bonding pad;
  - a nickel-vanadium layer over the adhesion layer;
  - a wettable layer over the nickel-vanadium layer; and
  - a barrier layer over the wettable layer.
- [c2] 2. The under-ball-metallurgy layer of claim 1, wherein the barrier layer includes a material selected from the group consisting of nickel, iron and cobalt.
- [c3] 3. The under-ball-metallurgy layer of claim 1, wherein the adhesion layer includes one selected from the group consisting of titanium, tungsten, titanium-tungsten alloy and chromium.
- [c4] 4. The under-ball-metallurgy layer of claim 1, wherein the wettable layer includes one selected from the group consisting of copper, nickel, iron and cobalt.
- [c5] 5. The under-ball-metallurgy layer of claim 1, wherein the adhesion layer includes a sputtering adhesion layer.

- [c6] 6. The under-ball-metallurgy layer of claim 1, wherein the nickel–vanadium layer includes a sputtering nickel–vanadium layer.
- [c7] 7. The under-ball-metallurgy layer of claim 1, wherein the wettable layer is formed by sputtering, electroplating or electroless plating.
- [c8] 8. The under-ball-metallurgy layer of claim 1, wherein the barrier layer includes an electroplating barrier layer.
- [c9] 9. The under-ball-metallurgy layer of claim 1, wherein the under-ball-metallurgy layer further includes a second wettable layer made of copper or copper alloy over the barrier layer.
- [c10] 10. An under-ball-metallurgy layer between a bonding pad on a chip and a solder bump, wherein material of the solder bump includes tin, the under-ball-metallurgy layer at least comprising:
  - an adhesion layer over the bonding pad;
  - a nickel–vanadium layer over the adhesion layer;
  - a wettable layer over the nickel–vanadium layer; and
  - a barrier layer over the wettable layer, wherein the barrier layer is a barrier preventing the penetration of nickel atoms from the nickel–vanadium layer.

- [c11] 11. The under-ball-metallurgy layer of claim 10, wherein the barrier layer includes one selected from the group consisting of nickel, iron and cobalt.
- [c12] 12. The under-ball-metallurgy layer of claim 10, wherein the adhesion layer includes one selected from the group consisting of titanium, tungsten, titanium-tungsten alloy and chromium.
- [c13] 13. The under-ball-metallurgy layer of claim 10, wherein the wettable layer includes one selected from the group consisting of copper, nickel, iron and cobalt.
- [c14] 14. The under-ball-metallurgy layer of claim 10, wherein the under-ball-metallurgy layer may further include a second wettable layer made of copper or copper alloy over the barrier layer.
- [c15] 15. An under-ball-metallurgy layer between a bonding pad on a chip and a solder bump, wherein material of the solder bump includes tin, the under-ball-metallurgy layer at least comprising:
  - an adhesion layer over the bonding pad;
  - a wettable layer over the adhesion layer; and
  - a nickel-vanadium layer over the wettable layer.
- [c16] 16. The under-ball-metallurgy layer of claim 15, wherein the adhesion layer includes one selected from the group

consisting of titanium, tungsten, titanium–tungsten alloy and chromium.

- [c17] 17. The under-ball-metallurgy layer of claim 15, wherein the nickel–vanadium layer includes a sputtering nickel–vanadium layer.
- [c18] 18. The under-ball-metallurgy layer of claim 15, wherein the wettable layer includes one selected from the group consisting of copper, nickel, iron and cobalt.
- [c19] 19. The under-ball-metallurgy layer of claim 15, wherein the nickel–vanadium layer includes a sputtering nickel–vanadium layer.
- [c20] 20. The under-ball-metallurgy layer of claim 15, wherein the under-ball-metallurgy layer may further include a second wettable layer made of copper or copper alloy over the nickel–vanadium layer.